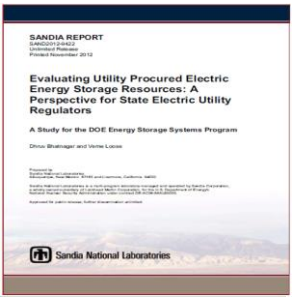
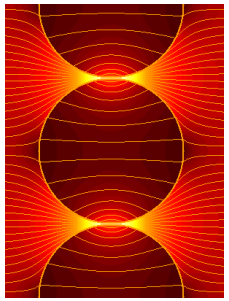
EMA Electrical Energy Storage Applications, Technologies & Systems Workshop





Energy Storage: Policies, Market Opportunities, Challenges, and Gaps

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Singapore

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Sandia National Laboratories

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EMA Technical Workshop

ES and Policy Presentation Outline

- Energy Policy – The Basics
- The Energy Policy Framework
  - Definition
  - Objectives
- Standards – Integrated Policy Instruments
- Challenges, Opportunities, Barriers, and Gaps
  - Workshop Teaser
  - Coming to suite of answers for role of policy, regulatory environment in the advancement of energy storage applications and technologies

Simple Definition of Energy Policy

Energy policy is –

How a given entity *(usually a government)*

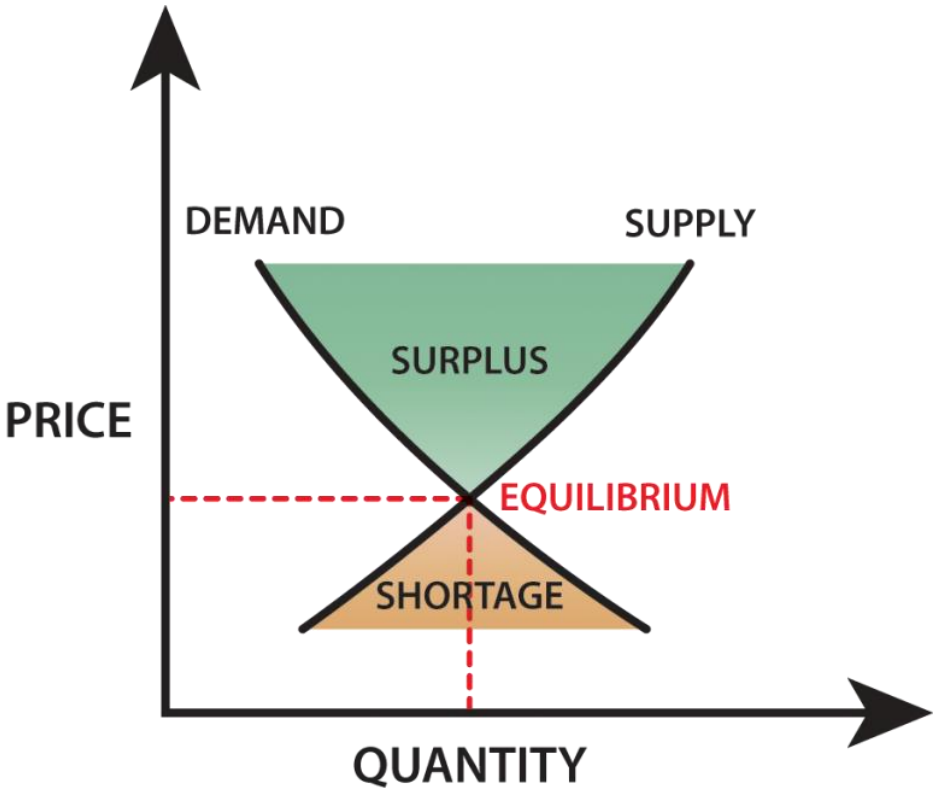
has determined to address

Energy Development issues (in particular):

- Energy Consumption
- Energy Production
- Energy Distribution

Energy Policy – The Basics

Energy Policy & Market Analysis, when aligned with Technology is a multifaceted area affecting the supply and demand balance.



The fundamentals

do not

change over time

What is a Framework?

Framework Definition

A framework is a model. It is a hypothetical description of a complex entity or process. The description includes the underlying structure for a group of components or elements that work interactively to support an issue or concept such that one responding to questions or problems delivers consistent output, answers, or potential solutions.

Developing a Framework : How to Reach Energy Policy Goals

QUESTIONS must GENERATE more QUESTIONS to

- Develop an integrated framework
  to assess the interaction of energy supply and infrastructure alternatives
- Provide perspective
  on a broad range of energy policy questions
- Understand how to ask an energy policy question
- Have confidence in the approach for how one begins to respond to energy policy questions

An Integrated Policy Model : Putting the pieces together

Industry requires an integrated model when energy policy is mandated.

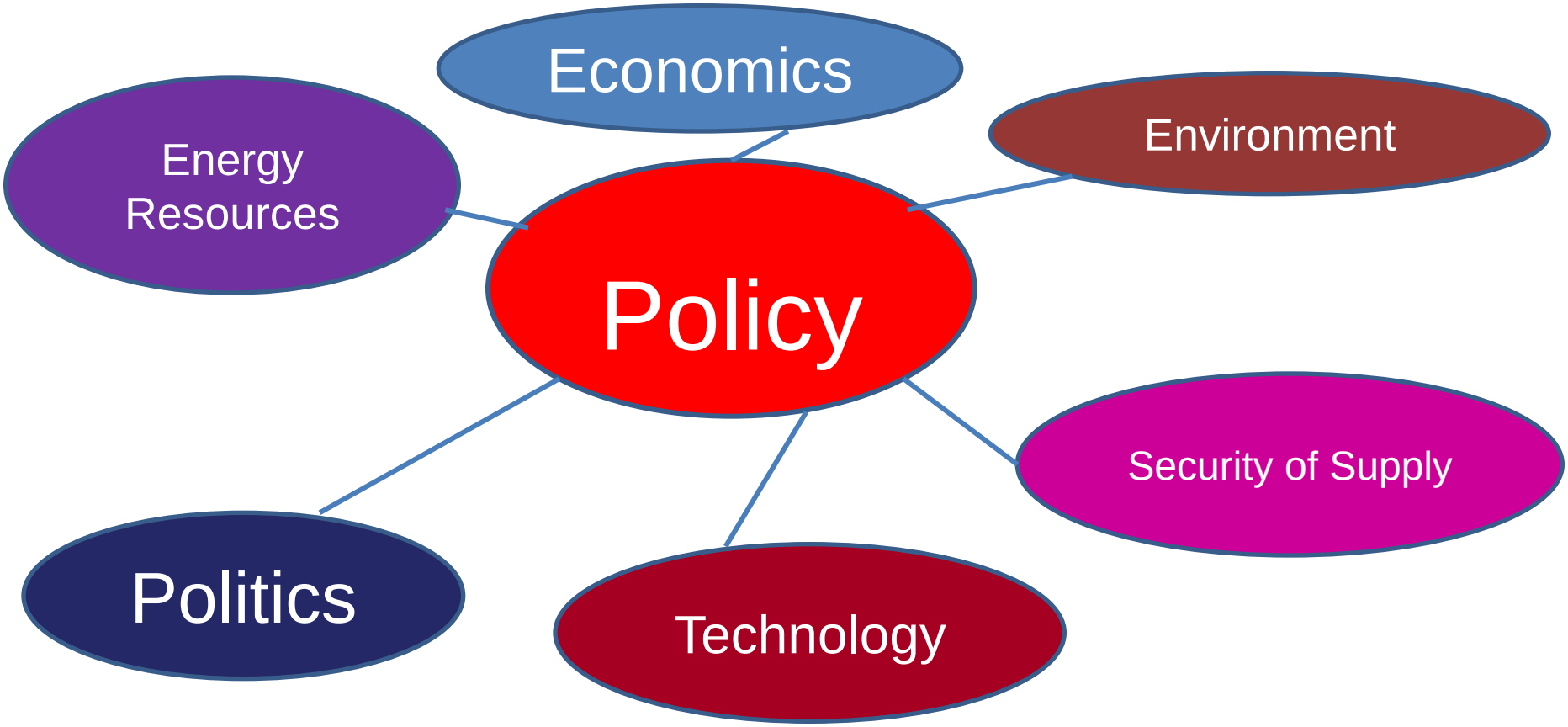
Six underlying structures in any energy policy model:

- Energy resources
- Economics
- Environment
- Technology
- Politics
- Security of supply

ALL PROPPED UP BY APPLIED STANDARDS

Integrated Energy Policy and Standards Complexities (Current Examples)

Based on work by Hong Jian Yang, Feb 2006



Integral Policy Framework Elements Explained

- Economics – *open to all private participants; investors require the right signal for guarantee of Return on Investment (ROI)*
- Energy resources – *movement toward use of clean (er) energy sources*
- Environment & Technology – *Individuals make choices consistent with society's best interests*
- Security of Supply – *Dependence on the network infrastructure that MUST be maintained with system coordination*
- Politics – *to work, this framework element requires impartial evaluation and frequent monitoring of market performance & incorporation of competitive markets*

MY ASSIGNMENT Today

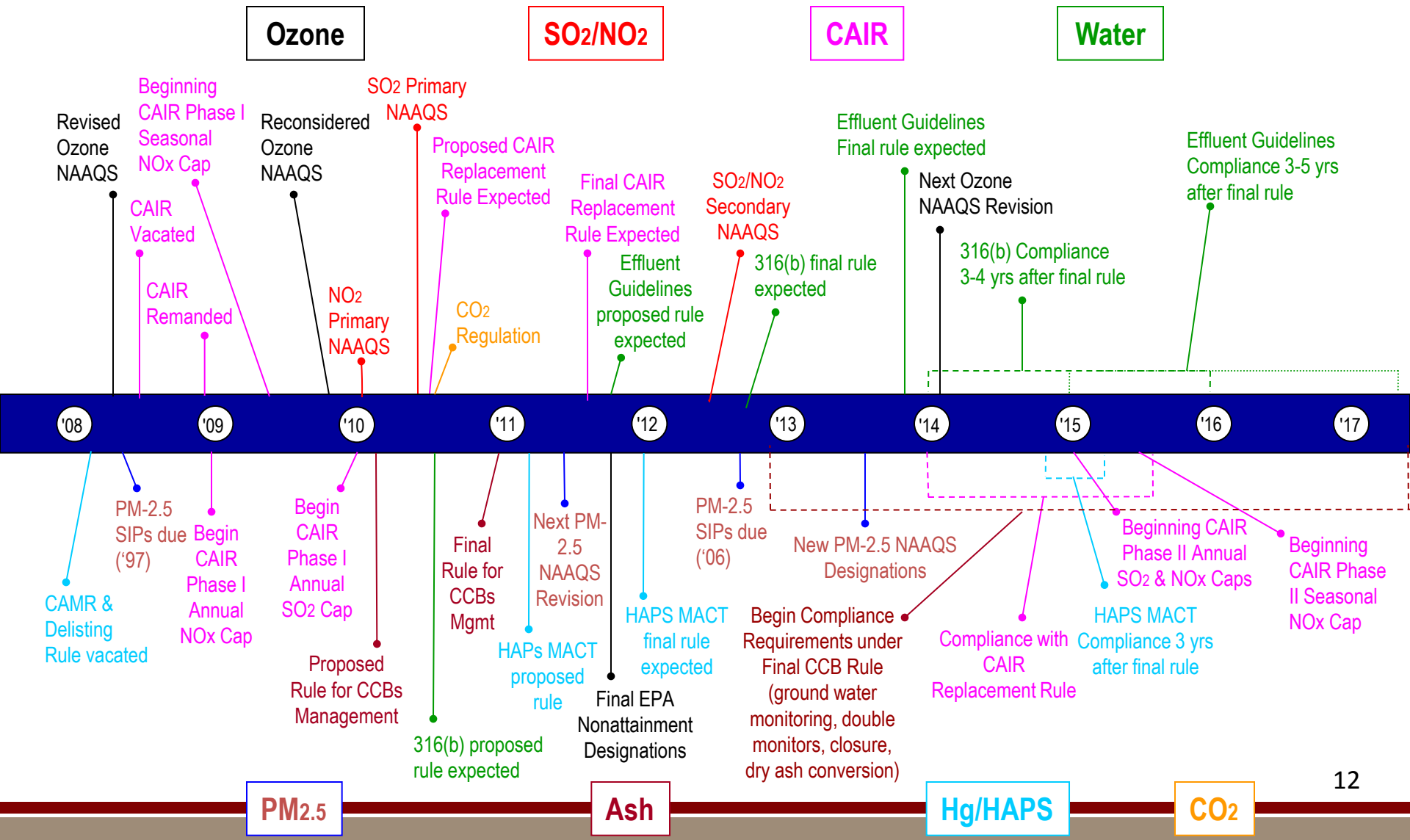
Mission Possible:

In 15 minutes or less identify and explain how current local and national regulatory processes that are in play with respect to energy storage impact the use, cost, availability and reliability of electric power delivery system in a global perspective while taking into account social, environmental, economic, socio-political policies that inevitably involve technical challenges, opportunities, barriers, and gaps while considering a complex asset whose generation can be resource neutral!

Back to the Basics: A Subset of U. S. Energy Storage Alphabet Soup

- EPA: Environmental Protection Agency
- FERC: Federal Energy Regulatory Commission
- NIST: National Institute for Standards & Technology
- CFTC: Commodities Future Trading Commission
- DOE: (U.S.) Department of Energy
- FCC: Federal Communications Commission
- NERC: North American Reliability Corporation
- STATE PUCs, LEGISLATURES/ Public Utility Commissions

Environmental Regulatory Timeline for Fossil Fuel Plants/Coal Units



-- adapted from Wegman (EPA 2003)

EPA Rules: PROBABLE IMPACT (excluding CO2)

- Shutdown of 40-100 GW of coal-fired generating capacity
- Increase in demand for natural gas for electric generation (1.7 TCF/year)
- Market impacts in some regions

FERC

Federal Energy Regulatory Commission

- VERS Integration
- Inter-regional transmission planning and cost allocation for “public purpose” lines
- Feed-In Tariffs (FIT)
- National Action Plan for Demand Response (NAPDR)

DOC/National Institute for Standards & Technology (NIST)

- Standards for Smart Grid Interoperability
- Standards for Cyber Security

COMMODITIES FUTURES TRADING COMMISSION (CFTC)

- Are long-term power contracts subject to margin calls?
- Are Financial Transmission Rights (FTRs) subject to margin calls?
- What us the role or advantage of the end user vs. speculator?

DOE

- Appliance Efficiency Standards
- 2011 calendar has 73± preliminary/final rules
- Source vs. Site impact

FEDERAL COMMUNICATIONS COMMISSION (FCC)

- National Broadband Plan
- Who owns consumer data?
- How do we satisfy the privacy concern (i.e., smart grid, demand response, etc.)?
- What is the spectrum availability for utilities?

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION (NERC)

- Mandatory Reliability Standards
- Mandatory Cyber-Security Standards
- Critical Infrastructure Protection – Physical & Cyber
- Role of FERC/DHS/NSC/etc.

STATE PUCs (Public Utility Commissions)

- Efficiency Standards
- Smart Grid Investments
- Maximum Use Standards
- CO_2 Standards
- Renewable Energy Standards
- Clean Energy Standards
- States vs. Federal Regulatory Drivers

Reference: Bhatnagar D. and Loose V. "Evaluating Utility Procured Electric Energy Storage Resources: A Perspective for State Electric Utility Regulators." Sandia National Laboratories. SAND2012-9422. November 2012.

RECENT US POLICY AND LEGAL IMPLICATIONS FOR ENERGY STORAGE VIS-À-VIS RPS MANDATES

Statement of

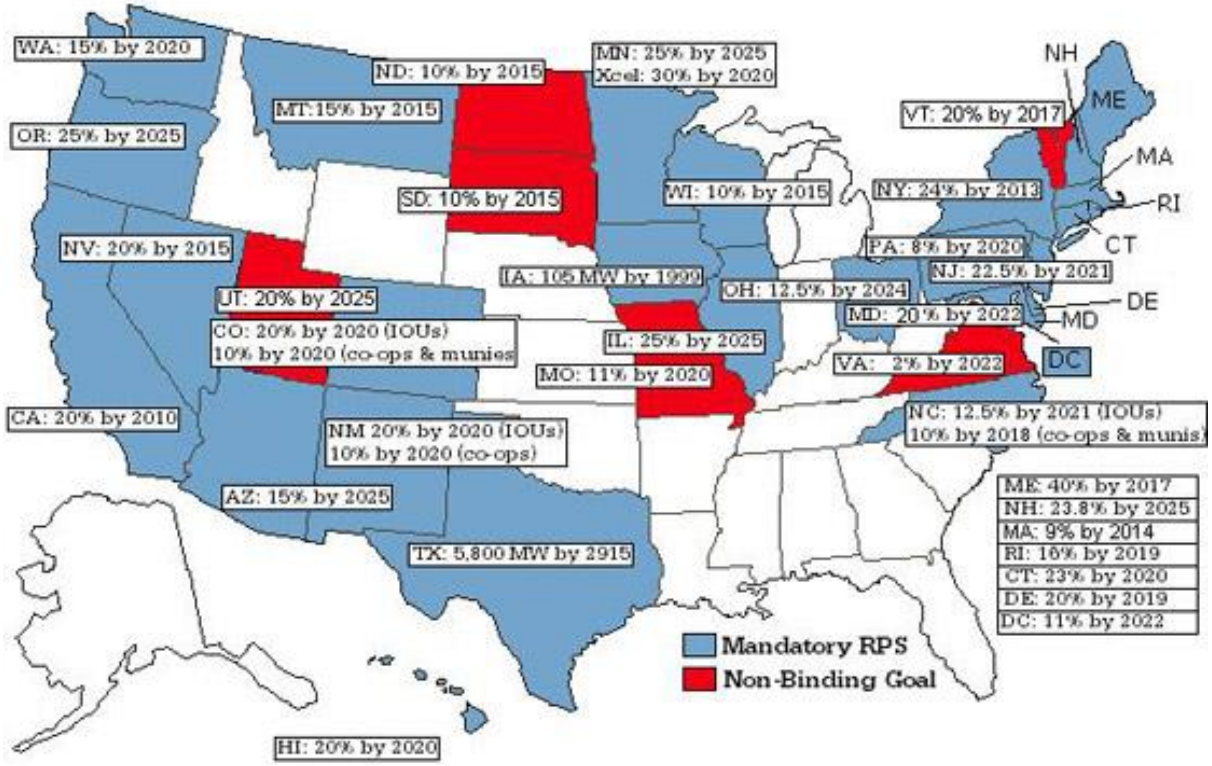
Problem

The Issues

Some

Considerations

Recommendations



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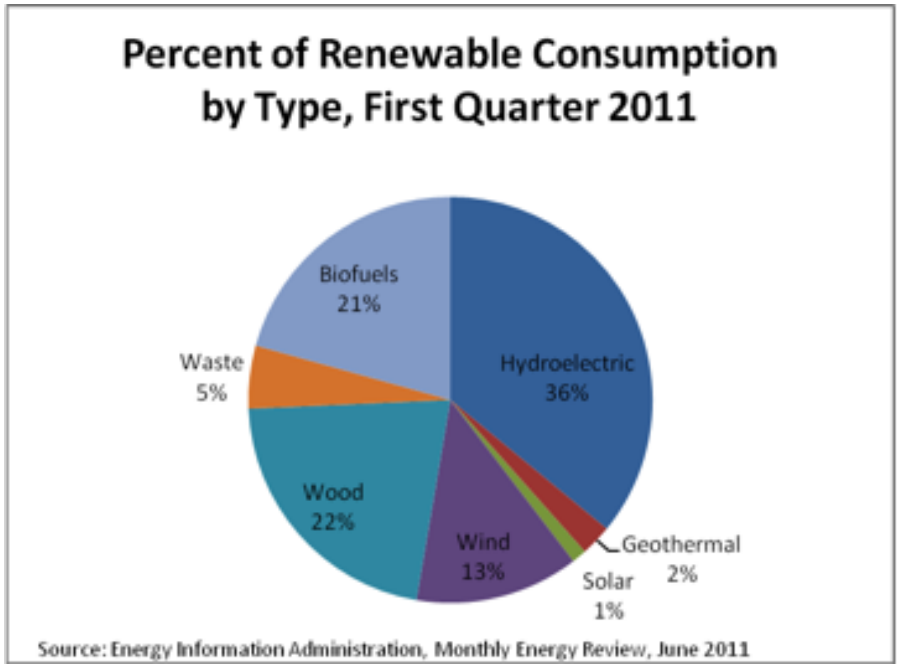


California Renewables Portfolio Standard (RPS)
Established in 2002 under Senate Bill 1078 and accelerated in 2006 under Senate Bill 107, California's Renewables Portfolio Standard RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources by at least 1% of their retail sales annually, until they reach 20% by 2010.

- There is no U.S. federal policy for RPS
- The regulations for RPS (about 40% of US electricity sales) vary from state to state or are non-existent;
- Importing Variable Energy Resources (VERs) into the grid affect reliability;
- Energy storage was not specifically written into the legislation for RPS; &

There are **environmental** and market policies that affect the use of electrical energy storage at the federal, state, and local levels.

ES Policies, Opportunities

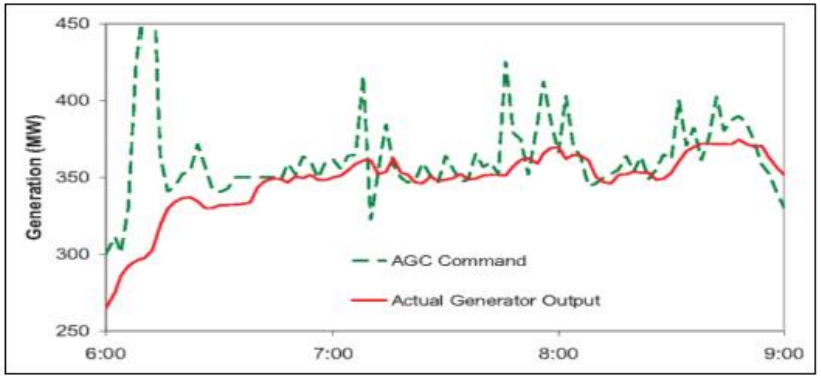
- Federal Initiatives
  - FERC Order 755 and 784
  - FERC Order 1000
- State and Regional Efforts
  - New Mexico
  - California
  - Texas
  - Hawaii

Federal Storage Policy Develop

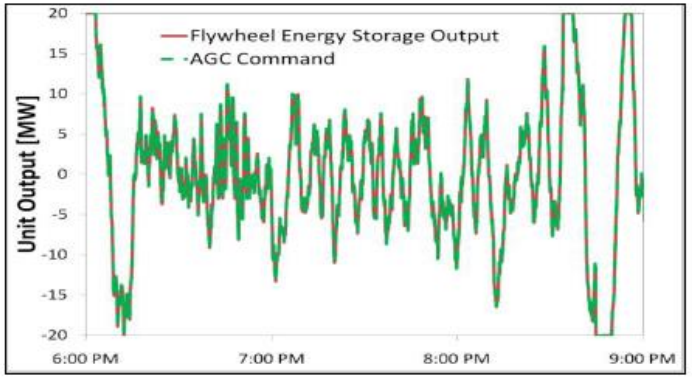
FERC Order 755

Pay for performance for frequency regulation

- Implemented in PJM, MISO, NYISO, CAISO. 2015 for ISO-NE



Slow Ramping of Conventional Generator



Flywheel / Battery Energy Storage Example

Sources Kirby, B. "Ancillary Services: Technical and Commercial Insights." Wartsilla, July, 2007. pg. 13

Federal Storage Policy Developments

FERC Order 784: 3rd Party Provision of Ancillary Services

- Allows 3rd party ancillary service procurement for transmission public utilities
- Requires a consideration of speed and accuracy
- Simplifies and streamlines storage accounting procedures
  - Production, transmission and distribution

Storage Act in Congress

- Storage Technology for Renewable and Green Energy Act
  (2013 STORAGE)
- 30% ITC for businesses, 20% ITC for grid-scale energy storage

Federal Storage Policy Develop

FERC Order 1000: Regional Transmission Planning

- The order specifies how public utility transmission providers plan for new transmission projects and allocate those costs.
- Reliability transmission upgrades, market efficiency transmission upgrades and public policy transmission upgrades

- *Order 1000 is broken into three main requirements.*
  - Planning: non-transmission solutions considering public policy requirements
  - Cost allocation requirements across beneficiaries
  - Nonincumbent developer requirements: merchant transmission encouragement.

State Energy Storage Developments & Demonstration Projects

New Mexico

- PNM Prosperity Project (500kW PV with 750 kW energy storage)
- Mesa del Sol PV and Energy Storage
- Japan-US Collaborative Smart Grid Project, 1MW NaS, Los Alamos
- NEDO NM Smart Grid Demonstration Project , 800kW, Los Alamos

Hawaii

- The Hawaii Electric Companies modeled energy storage as a supply-side resource option in their 2013 IRP (integrated resource plan).
- Maui is actively considering the installation of energy storage to address wind curtailment.

Texas

Existing Resources

- 32MW/28MWh Battery at Notrees Wind Farm
- 4MW/28MWh NaS Battery in Presidio, TX
- 1 MW AES Energy Storage System

Current Policy/Market/ES Technology Initiatives

- State Bill 943: Defines energy storage as a generation asset that must register as such when used to sell energy or ancillary services in the wholesale market- same interconnection rights and transmission access

California

- SGIP storage incentives for behind the meter (customer) projects (funded from customer bill surcharge): $2/W up to 3MW for renewable powered energy storage
- SCE 50 MW procurement target for 2021 + designation as a preferred resource
- AB2514: Assigned Commissioner's Ruling setting storage procurement targets: 1.325 GW proposed for IOUs for 2020 (Carla Peterman)

Texas

Current Initiatives

- PUCT Docket 39917 and ERCOT Nodal Protocol Revision 461
  - energy storage, during both charge and discharge modes, would be considered a wholesale transaction and settled at the node, rather than zonally like load and face retail rates and associated retail transmission and ancillary services charges
- Fast Responding Regulation Service (FRRS) Pilot
  - Similar to FERC Order 755 for ERCOT (Electric Reliability Council of Texas)
- Emerging Technologies Working Group in ERCOT
  - identifies potential revisions to ERCOT rules to help increase the participation of emerging technologies

Energy Storage Challenges

- ## Value of Energy Storage to Users

Energy storage systems have characteristics of generation, load, and grid assets – complicates the rules of ownership and operation

- ## Grid-Ready Status

Proven track record of safety, performance, reliability, and resilience of energy storage services (and products) in grid-connected applications

Energy storage products with proven communication and control elements for smart grid operation

- ## Market / Regulatory Guidance

How can energy storage be monetized across a variety of regulatory and market structures?

- ## Investment/Business Case: Cost Justification

Business justification that show energy storage system which delivers multiple benefits is cost-effective when all of its services and benefits are recognized: regulation, system capacity, peak shaving, capital deferral of transmission or distribution investments

U.S. Market Barriers to Energy Storage

- Regulatory Issues at the state and federal levels
- Market issues that affect non-ISO/RTO and ISO/RTO markets
- Utility and developer business model issues
- Technology issues that affect ES applications
- Cross-cutting issues that bridge these categories

Bhatnagar D. , Hernandez, J et al. "Market and Policy Barriers to the Deployment of Energy Storage." Sandia National Laboratories. SAND2013-7606. September 2013.

Available at sandia.gov/ess

Energy Storage Policy/Market/Technology Gaps

1. Proper development of an innovative business model that includes risk in the energy storage market (and therefor continued technological advances).

2. Research, data, documentation of specific energy storage system (ESS) cyber security policies and procedures for managing potential threats, incidents and responses.

Comprehensive Statement: Opportunities, Challenges, Gaps

Business Model Considerations

- Strategic Plan
- Capabilities
- Product(s)

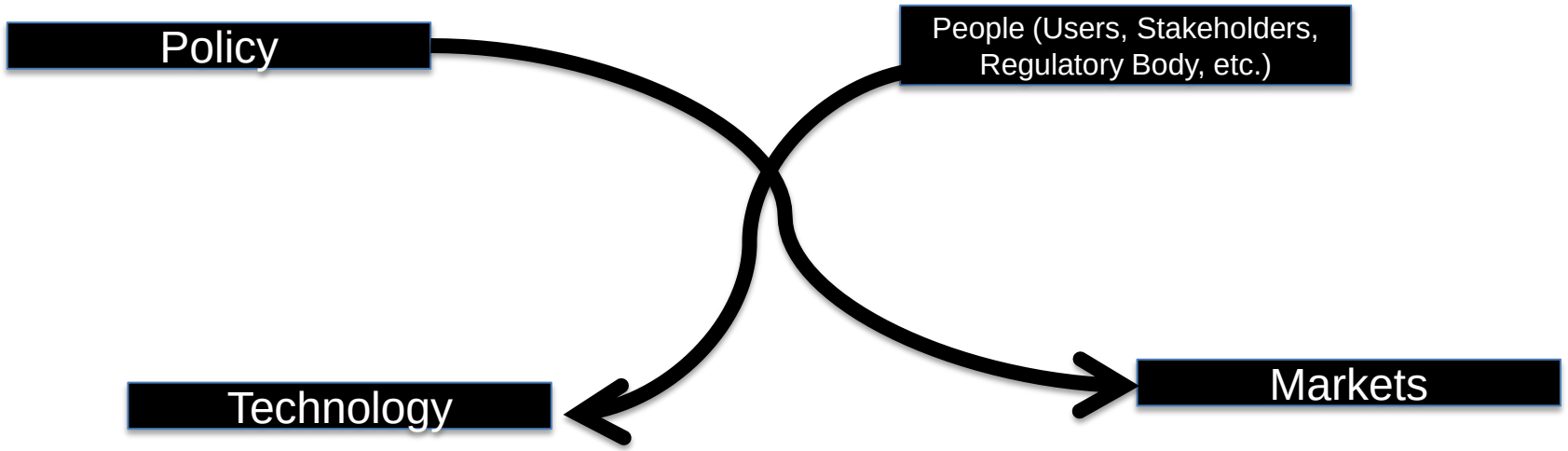
Cyber Security Policy & Documentation

- Strategy
- Comprehensive Policy
- Threat Reduction
- Incident Response
- Operations Standards
- Recovery
- Law Enforcement
- Communications Infrastructure

Summary Overview

This presentation achieved the following for the topic:

- Setting the Stage – the basics do not change
- Answering the question: Why are we here– address the confluence of policy, markets, and technology



- Developing the Next Question-
  1. Correct/innovative ES business model
  2. Establish cyber protocol for ESS

Lessons Learned & Workshop Participants

Facilitated Discussion: *Key issues to consider when developing and implementing national policies for energy storage:*

- Local impacts of national policy choices
- Mitigation of barriers to using innovative technologies, applications, and approaches
- Challenge of making effective policy choices in the absence of data or with challenging data; how to address the need for more comprehensive research when establishing demonstration projects
- Importance of coordination among government and non-government entities, stakeholders for new/innovative technologies in energy storage
- Attention to uncertainties that affect the (energy) markets

Contact Information

Thank you for your attention!

If you have questions, contact

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